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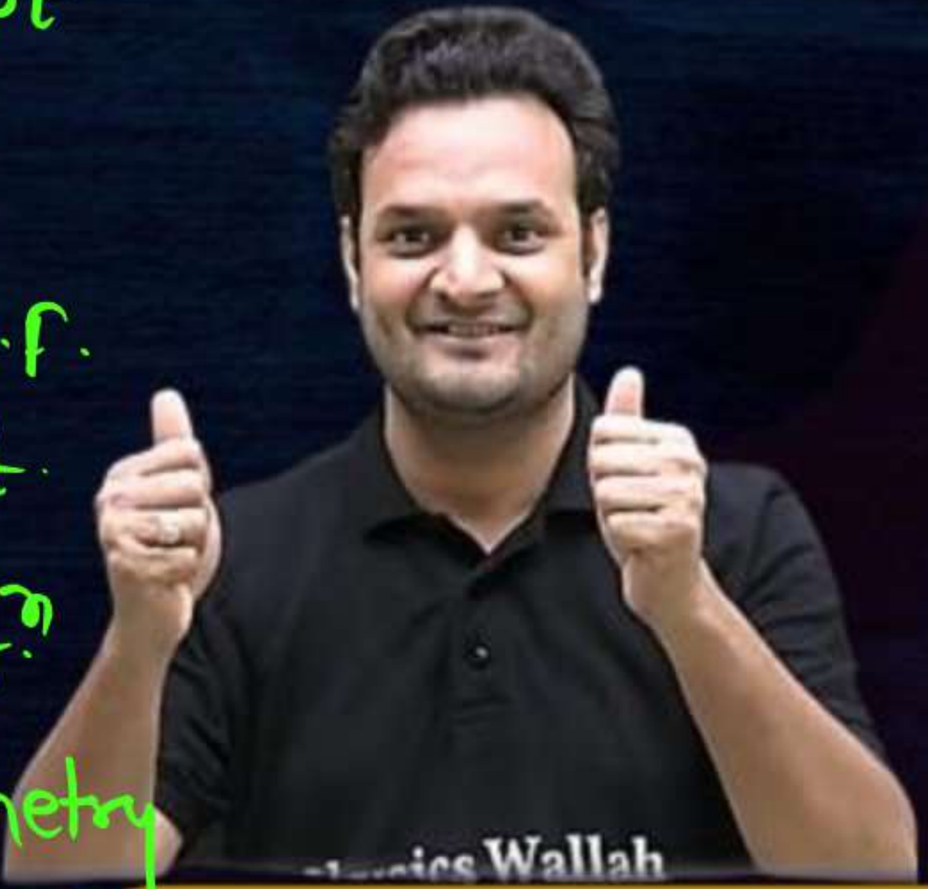
JEE

Test syllabus = Complete concept

LECTURE - 05

Atomic structure

(1) Mole
(1) E.F. & M.F.
(1) - Avg. wt.
(2) Concentrat?
(2) Stoichiometry
(1) Limiting Reagent



Sarvesh sir

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TABLE OF CONTENT

01 Bohr's theory

02

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Q 8 eV photon incident on metal plate, work function of metal plate is 6 eV. than calculate K.E. of emitted electron

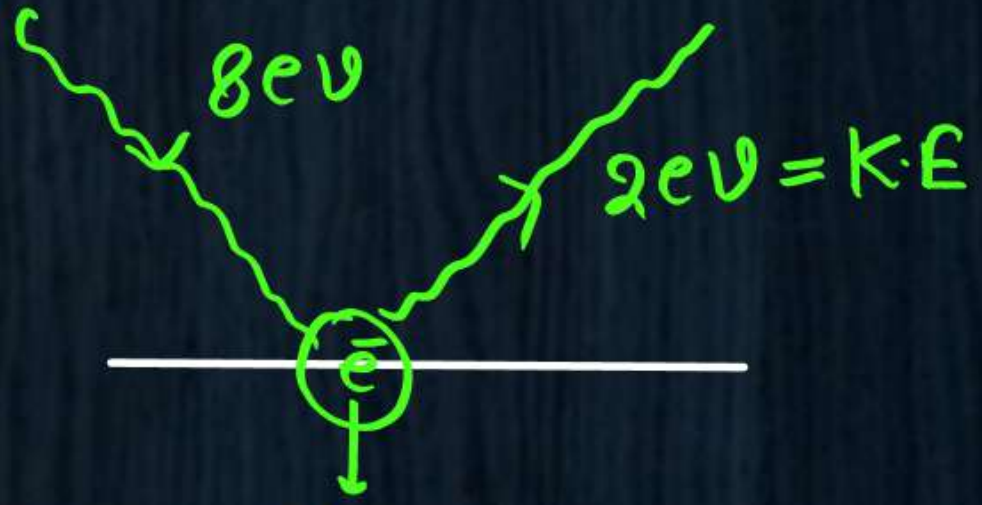
(a) 2×10^{-19} Joule

(b) 2 Joule

(c) 2.8×10^{-19} Joule

✓ (d) None of these

60 sec →



$W_0 = 6\text{ eV}$

$h\nu = W_0 + K.E.$

$8\text{ eV} = 6\text{ eV} + K.E.$

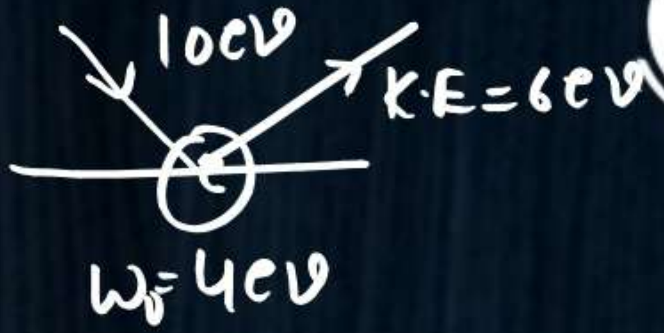
$K.E = 2\text{ eV}$

$K.E = 2\text{ eV}$

$= 2 \times 1.6 \times 10^{-19}$ Joule

$= 3.2 \times 10^{-19}$ Joule

Intensity of light



Intensity = total number of photon incident on metal plate per unit area or volume

$\underline{\underline{C_{SD} = 9}}$

Intensity (I) ⇒ meaning ⇒ No. of incident photon (energy same hai)

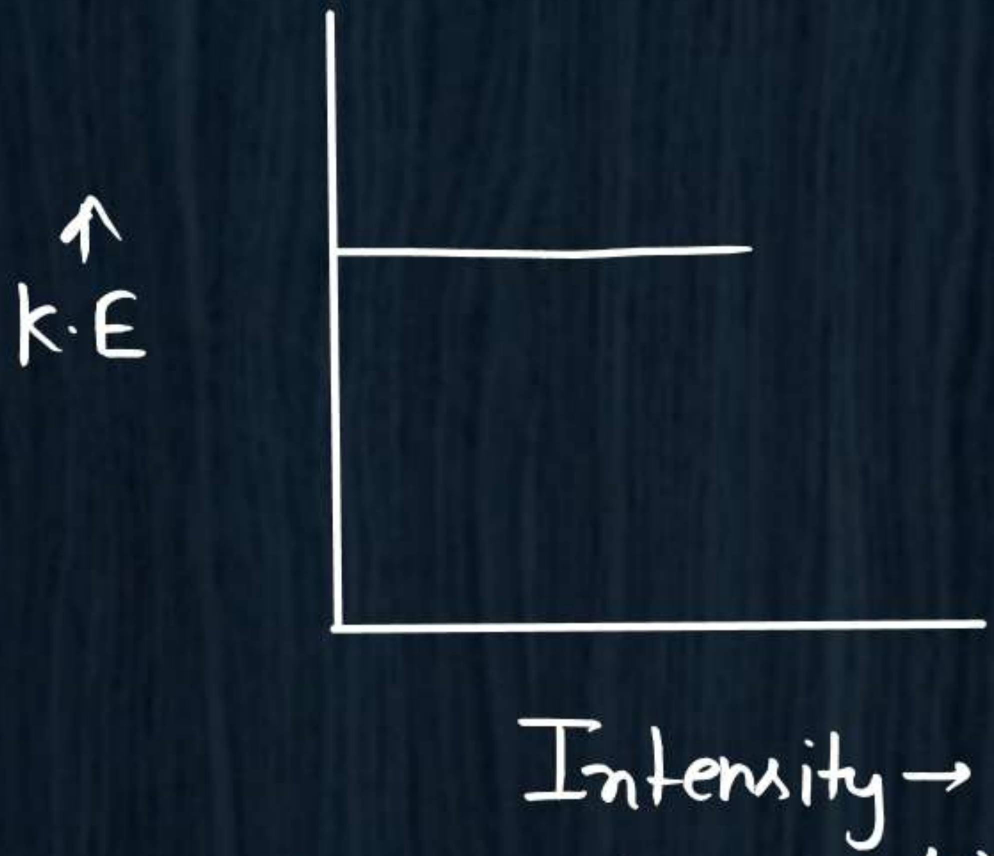
Intensity → ↑ ⇒ No. of incident photon = increases

Intensity → ↓ ⇒ No. of incident photon = decreases

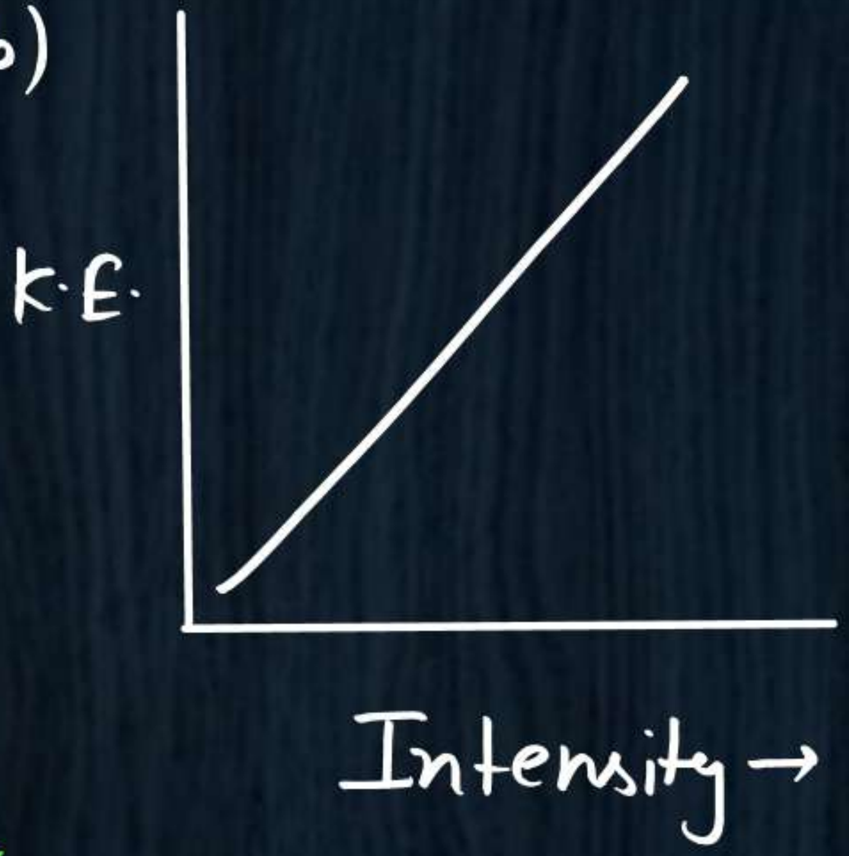
① Intensity → ↑ (increase) ⇒ $\begin{cases} (K.E.)_c \Rightarrow \text{same} \\ \text{No. of emitted } \bar{e} = \text{increases} \end{cases}$

Q

(a) ✓✓



(b)



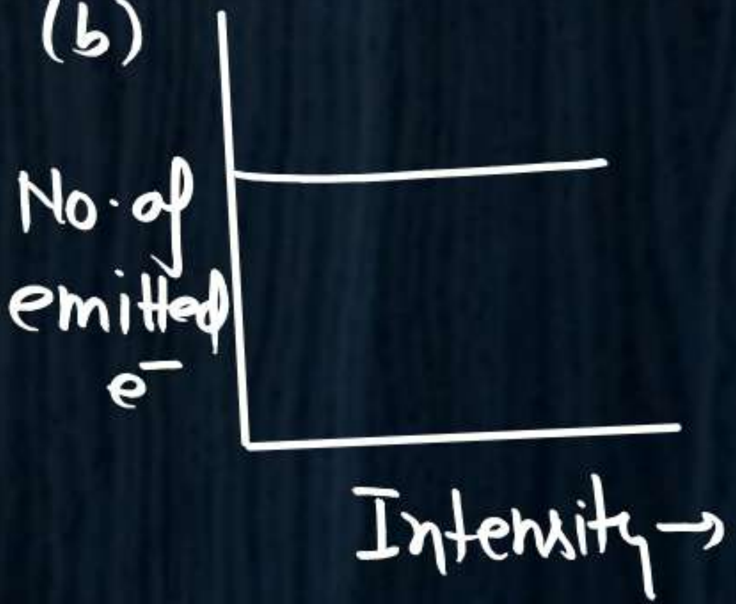
Correct graph

K.E. Vs (Intensity)

Q → select correct graph

(a) ✓✓

(b)

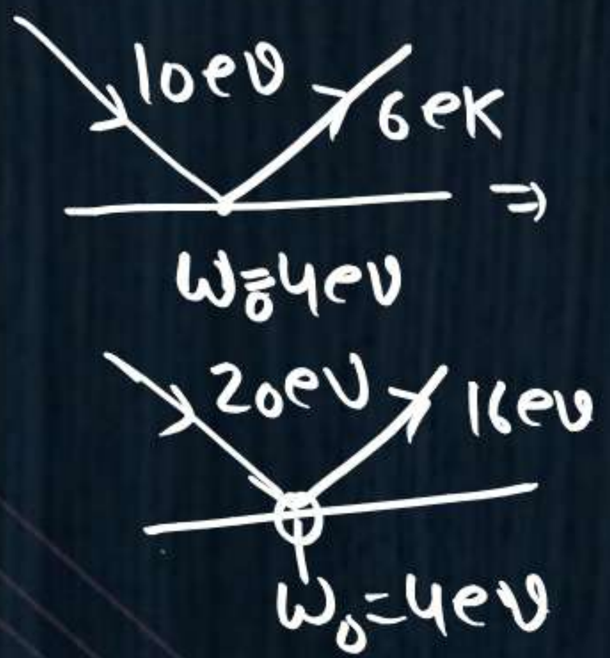


$C_{SD} = 9$ (b)

frequency of incident photon(ν) = increasing ⇒ meaning
↓
Energy of photon increase kr rahe ho $\left(E = h\nu = \frac{hc}{\lambda} \right)$

① $\nu \rightarrow \uparrow$ (increase) → ⇒ $(K.E.)_e = \uparrow$ (increase)

↳ ⇒ No. of emitted $e^- =$ same $(1e^-)$

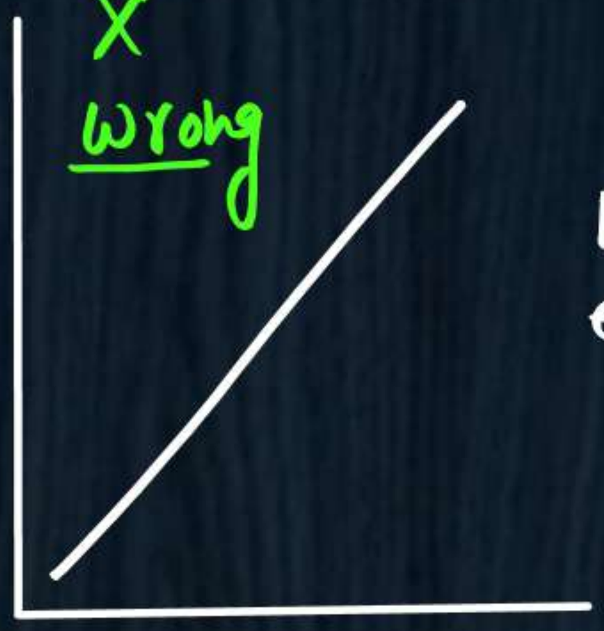


Q → (a)

K.E.

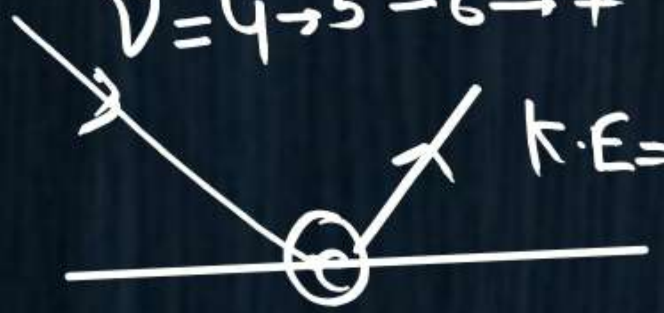
(b) X wrong

↑ K.E



No. of emit e^-

$\nu = 4 \to 5 - 6 \to 7$

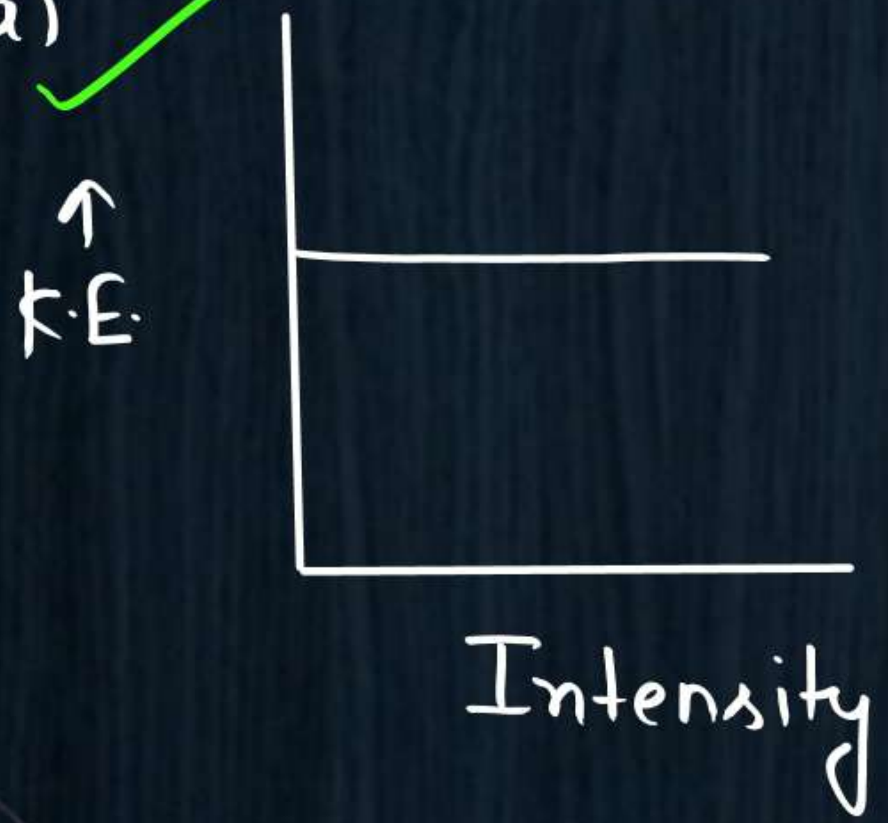


K.E $= 0 \to 1 \to 2 \to 3$

$\nu_0 = 4$

Q select correct graphical representation

(a) ✓

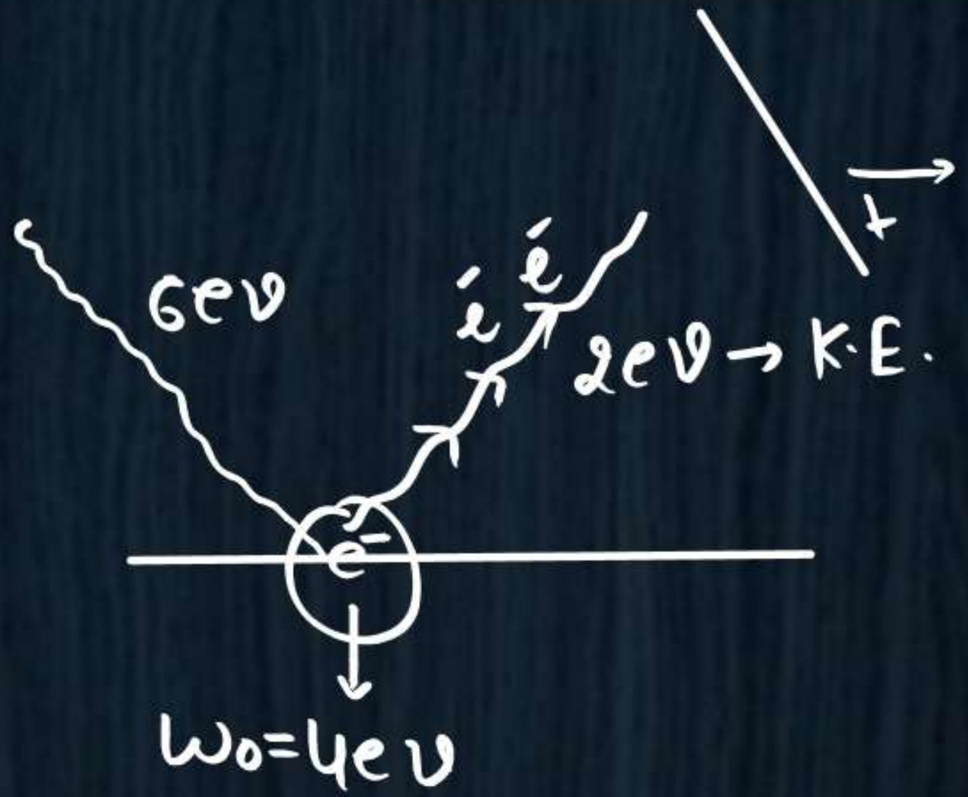


(b) ✗

(c) α

(d) all correct

stopping potential (Imp topic nahi hai → Chemistry)



→ voltage laga dete hai (opposite voltage)

→ Minimum required voltage or Potential (V_0) to stop emitted electron.

$$h\nu = W_0 + K.E.$$
$$h\nu = W_0 + eV_0$$

where → V_0 = stopping potential

→ $W = q \times V$ (physics 12th)

↓

$W = \underline{e \times V_0}$

↳ stopping Potential

$K.E = W_{\text{electrical work}}$

Bohr's theory

→ most imp. topic for mains & Adv.

60% →

* Bohr's Atomic model

(1.) Bohr's theory (model) only applicable for single electron species

Ex → H, He^{+}, Li^{+2}, Be^{+3}, B^{+4}

$e^{-} = 1, 1, 1, 1, 1$

Q. Select the species, which follows Bohr's theory

e

(a) He^{+2} → 0

20 sec → Ans batao

✓ (b) Li^{+2} → 1

(c) Be^{+2} → 2

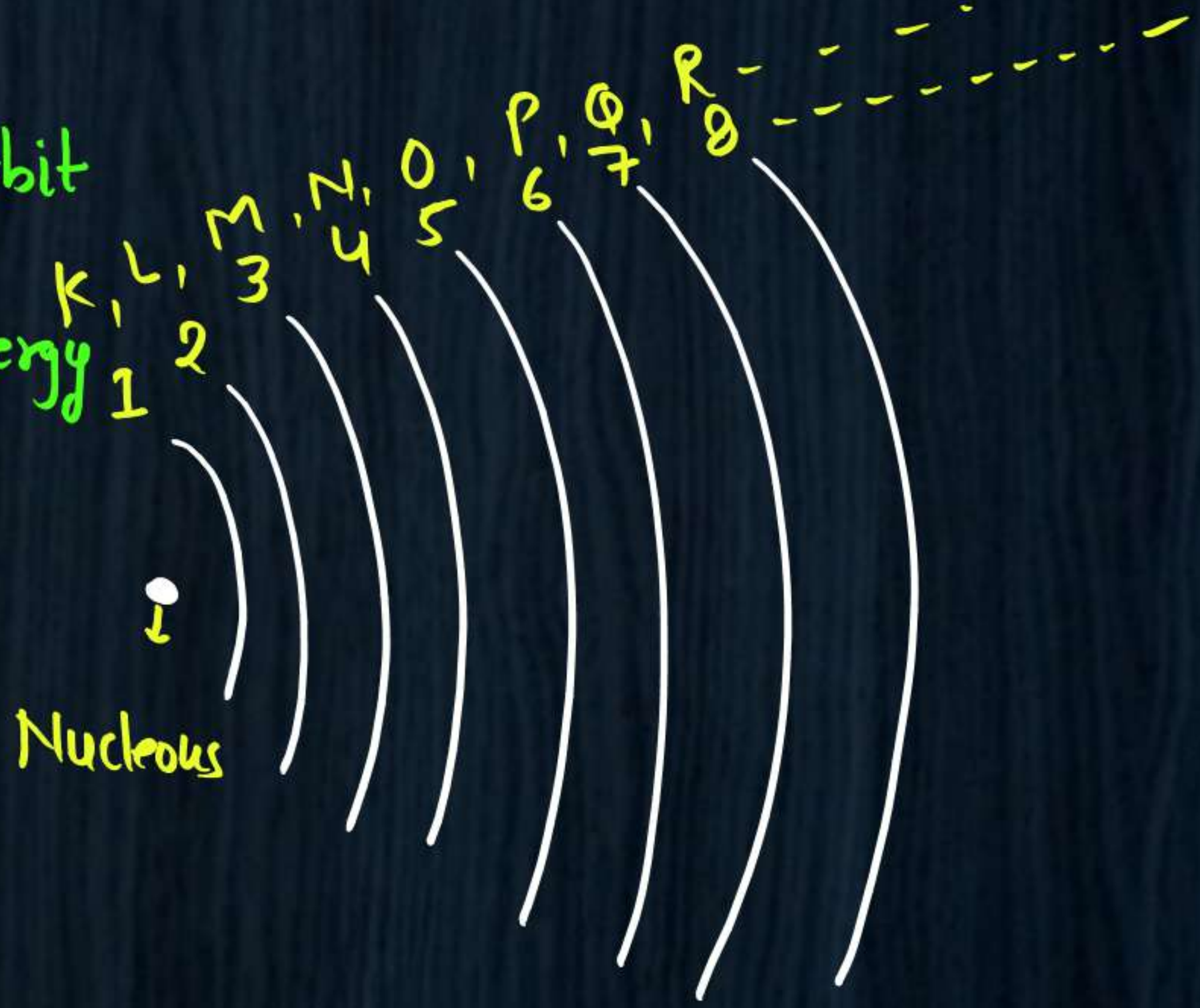
(d) H^{+} → 0

(2) Atom Consist of 2 parts —
- → Nucleous → (P, n) = 10^{-15} m
- → Extra nuclear parts — (e^{-}) = 10^{-10} m

(3) No. of circular energy level or orbits present in extra nuclear parts

Represented by = n ⇒ No. of orbit or No. of Energy level

⇒



(4) e^- revolving only those energy level or orbits, which have angular momentum $n \times \frac{h}{2\pi}$ (Integral multiple of $\frac{h}{2\pi}$)

↓

whole number se multiple ho

Angular momentum (mur) $= n \times \frac{h}{2\pi}$

→ $n = 1, 2, 3, 4, ----$ (n = No. of orbit or No. of energy level)

→ $n \neq 0$

→ $n \neq$ fractional

→ $n \neq$ negative

→ $\frac{h}{2\pi}, \frac{2h}{2\pi}, \frac{3h}{2\pi}, \frac{4h}{2\pi}, \frac{50h}{2\pi}$

→ $\frac{1}{2}\left(\frac{h}{2\pi}\right) = \frac{h}{4\pi}$ → ✗

→ $0 \times \frac{h}{2\pi} = 0$ → ✗

$$mur = \frac{n \times h}{2\pi}$$

where → m = mass of revolving e^-

r = Radius of orbit

u = Velocity of e^-

Q. Select the correct value of angular momentum of revolving e^-. (more than one Ans. is possible)

✓ (a) $\frac{h}{\pi} \longrightarrow \frac{2}{2}\frac{h}{\pi} = 2\left(\frac{h}{2\pi}\right)$

× (b) $\sqrt{2}\,\frac{h}{\pi} \longrightarrow \sqrt{2}\,\frac{h}{\pi}\frac{\times 2}{\times 2} = 2\sqrt{2}\left(\frac{h}{2\pi}\right)$

✓ (c) $3\,\frac{h}{\pi} \longrightarrow 3 \times \frac{2h}{2\pi} = 6\left(\frac{h}{2\pi}\right)$

(d) None of these

Q→ findout value of angular momentum of 4^{th} orbit revolving electron

(a) ✗ $\frac{h}{2\pi}$

✓ (b) $\frac{2h}{\pi}$

✗ (c) $\frac{4h}{\pi}$

✗ (d) $\frac{8h}{\pi}$

Sol^n ⇒ angular momentum $= n \times \frac{h}{2\pi}$

where → n = No. of orbit or No. of energy level

$n = 4$

$= 4 \times \frac{h}{2\pi} = \frac{2h}{\pi}$

Radius of atom

$$r_n = 0.529 \times \frac{n^2}{Z} \, \text{Å}$$

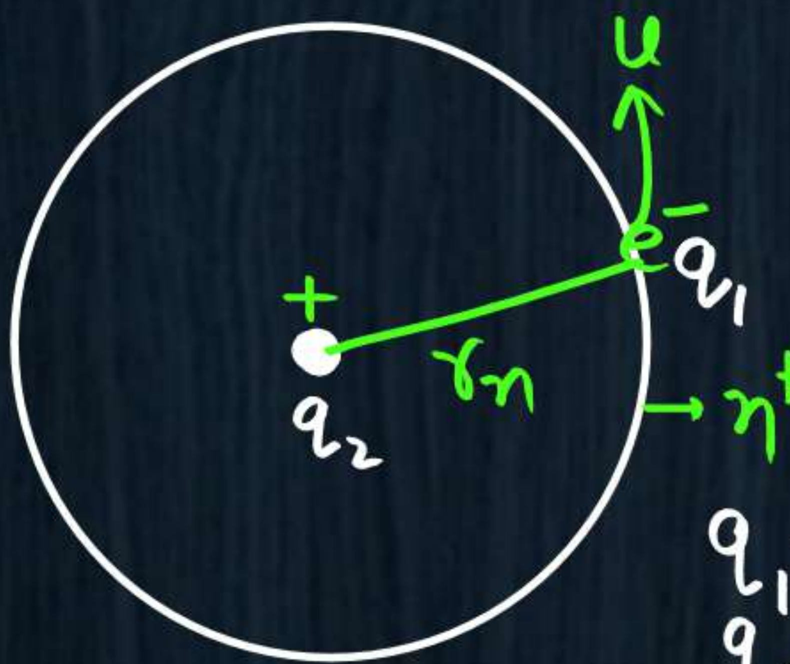
where → n = No. of orbit

Z = Atomic No. of species

$p = e$

$1p \rightarrow e^-$

$Zp \rightarrow Ze$



$q_1 = e$

$q_2 = Ze$

$$F_e = \frac{K q_1 q_2}{r^2}$$

Where → $K = 9 \times 10^9$

$$F_e = \frac{K Ze \cdot e}{r^2} = \frac{K Z e^2}{r^2} \quad \text{— (I)}$$

$$\text{Centrifugal force} = \frac{mu^2}{r} \quad \text{— (II)}$$

$$mur = \frac{n \times h}{2\pi}$$

$$\boxed{u = \frac{nh}{mr \times 2\pi}}$$

Li^{+2}

$Li = \underline{3} = Z = \underline{P}$

$1 \rightarrow 1.6 \times 10^{-19}$

$3 \longrightarrow 3 \times 1.6 \times 10^{-19}$

$\underline{3} \times e$

$= \underline{Z \times e}$

$$F_{centri-} = \frac{mu^2}{r} = \frac{m\left(\frac{nh}{2\pi mr}\right)^2}{r}$$

$$= \frac{\cancel{m} \times n^2h^2}{4\pi^2 m^{\cancel{2}} r^3} = \frac{n^2h^2}{4\pi^2 m r^3} \text{ —— (II)}$$

$$F_{centri-F} = F_e$$

$$\frac{n^2h^2}{4\pi^2 m \underline{r}\cancel{^3}} = \frac{KZe^2}{r\cancel{^2}}$$

*** $$\boxed{r = \frac{n^2h^2}{4\pi^2 m K \underline{Z} e^2}}$$

*** $$\boxed{r = 0.529 \times \frac{n^2}{Z} \, A^0}$$

$h = 6.6 \times 10^{-34}$ J·Sec | $m = 9.1 \times 10^{-31}$ Kg

$k = 9 \times 10^9$ | $e = 1.6 \times 10^{-19}$ C

$C_{SP} = 10$

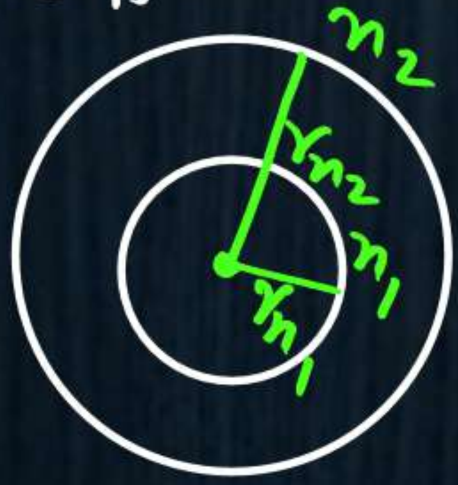
$$\Rightarrow r_n = 0.529 \times \frac{n^2}{Z}\ \text{Å}$$

→ $r_n \propto n^2$

→ $r_n \propto \frac{1}{Z}$

* yadi orbit ka number na diya jaye Questn me to humne $n=1$ suppose

Case-1 Relahon b/w Radius of two differen orbit in same Atom



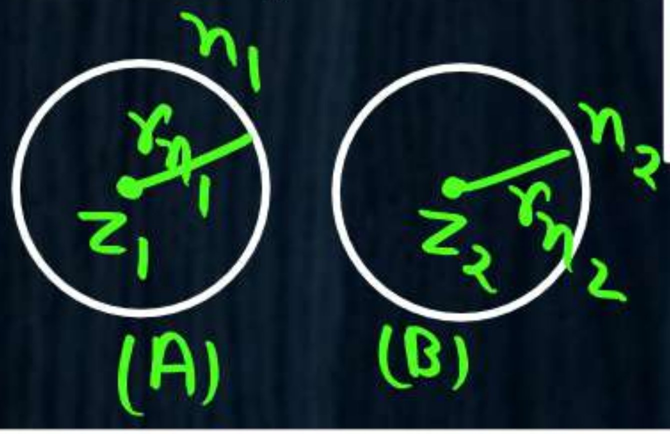
$$\frac{r_{n_1}}{r_{n_2}} = \frac{n_1^2}{n_2^2}$$

or $r_{n_1} : r_{n_2} = n_1^2 : n_2^2$

Case-2 → find out ratio of radius of n_1, n_2, n_3 --- orbits

$r_{n_1} : r_{n_2} : r_{n_3} \rightarrow n_1^2 : n_2^2 : n_3^2$ ---

Case-3 → Compare in two different species.



$$\frac{r_{n_1}}{r_{n_2}} = \left(\frac{n_1}{n_2}\right)^2 \left(\frac{Z_2}{Z_1}\right)$$

Q Calculate Radius of 1st bohr's orbit of H-atom

or

Calculate Radius of H-atom

Soln → $r_n = 0.529 \times \frac{n^2}{Z} \, A^0$

$n = 1$

$Z = 1$ (H-atom)

$\boxed{r_n = 0.529 \, A^0}$ → Radius of H-atom is called Bohr's Radius

$\boxed{a_0 = 0.529 \, A^0}$

Q. Calculate Radius ratio of 2nd bohr's orbit and 5th Bohr's orbit of H-atom.

(a) $\frac{2}{5}$

(b) $\frac{4}{5}$

✓ (c) $\frac{4}{25}$

(d) None of these

$$\frac{r_{n_1}}{r_{n_2}} = \frac{n_1^2}{n_2^2}$$

$$\frac{r_2}{r_5} = \frac{(2)^2}{(5)^2} = \frac{4}{25}$$

Q → Calculate ratio of radius of 2^{nd}, 3^{rd} & 4^{th} orbit of He^+ ion

(a) 2 : 3 : 4

(b) 4 : 9 : 16 ✓

(c) 8 : 27 : 64

(d) 1 : 2 : 3

$$r_2 : r_3 : r_4 = 4 : 9 : 16$$

$$r_{n_1} : r_{n_2} : r_{n_3} = n_1^2 : n_2^2 : n_3^2$$

M-2

$$r_2 = 0.529 \times \frac{(2)^2}{2} A^0$$

$$r_3 = 0.529 \times \frac{(3)^2}{2} A^0$$

$$r_4 = 0.529 \times \frac{(4)^2}{2} A^0$$

Q. The radius of the second Bohr orbit, in terms of the Bohr radius, a_0, in Li^{2+} is ______.

[2020 Main, 8 Jan. II]

A $\frac{2a_0}{3}$ $r \propto \frac{n^2}{Z}$

B $\frac{4a_0}{9}$

C $\frac{4a_0}{3}$ ✓✓

D $\frac{2a_0}{9}$

$$\frac{(r_{Li^{+2}})_2}{(r_H)_1} = \left(\frac{n_{Li}}{n_H}\right)^2 \times \frac{Z_H}{Z_{Li}}$$

$$\frac{r_{Li^{+2}}}{a_0} = \left(\frac{2}{1}\right)^2 \times \frac{1}{3}$$

$$r_{Li^{+2}} = \frac{4}{3}a_0$$

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Home work

pw - modules (Atomic structure)

→ Topicwise Question → Question No. → 1 to 17
Krna hai

→ DPP NO. = 3 Krna hai, Sunday Ko upload hogi
(only photoelectric Ke Questⁿ Krna)

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Thank - You

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